Mathematics Notes On Time & Distance

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Important formulae and facts of Time and Distance

Speed is a very basic concept in motion which is all about how fast or slow any object moves. We define speed as distance divided by time. Distance is directly proportional to Velocity when the time is constant.

- Speed Distance Time formula is mathematically written as- **Speed** = distance/time

Formula of Time :-time = distance/ Speed
So Formula of time is, time is equal to distance upon speed.

- **The formula of Distance: -Distance** = (Speed * Time)

Distance = Rate x Time

- To find rate, divide through into both sides by *time:*

Rate = Distance/Time

- ***The rate* is the distance** (given in units such as miles, feet, kilometers, meters, etc.) divided by time (hours, minutes, seconds, etc.). The rate can always be written as a fraction that has distance units in the numerator and time units in the denominator, e.g., 25 miles/1 hours.

So distance is simply speed into time.
Note: All three formulae that formula of speed, the formula of time and formula of distance are interrelated.

- **Convert from kph (km/h) to mps (m/sec)**
  For converting kph(kilometer per hour) to mps(meter per second) we use following formula

x km/hr=(*x*∗5/18) ***m/sec***

- **Convert from mps(m/sec) to kph(km/h)**
  For converting mps**(meter per second)** to kph**(kilometer per hour)** we use following formula

x ***m/sec***= X *(18/5) ***km/h***

- If the ratio of the speeds of A and B is a: b, then the ratio of the times taken by then to cover the same distance is: **1/a: 1/b or b: a**
- Suppose a man covers a certain distance at x km/hr and an equal distance at y km/hr. Then,
  the average speed during the whole journey is:- **2xy/(x + y)**
- The relation between time, distance, and speed: Speed is distance covered by a moving object in unit time: **Speed= Distance covered/ Time Taken**

Rule: 1: Ratio of the varying components when other is constant: Consider 2
objects *A* and *B* having to speed Sa, Sb.
Let the distance traveled by them are Da and Db respectively and time is taken to cover these distances be Ta and Tb respectively.
Let's see the relationship between time, distance, and speed when one of them is kept constant

- When speed is constant distance covered by the object is directly proportional to the time taken.
  ie; **If Sa=Sb** then **Da/Db = Ta/Tb**
- When time is constant speed is directly proportional to the distance traveled. ie; **If Ta=Tb** then **Sa/Sb=Da/Db**
- When the distance is constant speed is inversely proportional to the time taken ie if speed increases then the time is taken to cover the distance decreases. ie; If **Da = Db** then **Sa/Sb= Tb/Ta**

Rule 2: We know that when the distance traveled is constant, the speed of the object is inversely proportional to the time taken

1. If the speeds given are in Harmonic progression or HP then the corresponding time taken will be in Arithmetic progression or AP
2. If the speeds given are in AP than the corresponding time taken is in HP

Distance Constant

- If the distance traveled for each part of the journey, ie d1=d2=d3=...=dn=d, then average speed of the object is Harmonic Mean of speeds.
  Let each distance be covered with speeds s1,s2,...sn in t1,t2,...tn times respectively.
  Then t1 =d/s1
  t2 = d/s2
  tn =d/sn

then, Average Speed= [(d + d + d+ ... ntimes)]/ [d/s1 + d/s2+ d/s3+ ... d/sn
Average Speed= (n)/[(1/s1 + 1/s2+ .... 1/sn)]

Time Constant

- If time taken to travel each part of the journey, ie t1=t2=t3=…tn=t, then average speed of the object is Arithmetic

Let distance of parts of the journey be d1,d2,d3,...dn and let them be covered with speed s1,s2,s3,...sn respectively.
Then d1=s1 t , d2=s2t, d3=s3t, ... dn=snt
then , Average Speed= [(s1/t+ s2/t+ .... sn/t)/(t + t+ ... n times)]
Average Speed=(s1+ s2+s3+ … + sn)/n
Relative Speed

- If two objects are moving in the same direction with speeds *a* and *b* then their relative speed is **|a-b|**
- If two objects are moving in opposite direction with speeds *a* and *b* then their relative speed is**(a+b)**

Some Question on Above formulas

Ques 1:- A man covers a distance of 600m in 2min 30sec. What will be the speed in km/hr?

Sol:: Speed =Distance / Time

=Distance covered = 600m, Time taken = 2min 30sec = 150sec

Therefore, Speed= 600 / 150 = 4 m/sec

= 4m/sec = (4*18/5) km/hr = 14.4 km/ hr.

Ques 2:- A car travels along four sides of a square at speeds of 200, 400, 600 and 800 km/hr. Find average speed.?

Sol: Let x km be the side of square and y km/hr be average speed

Using basic formula, Time = Total Distance / Average Speed

x/200 + x/400 + x/600 + x/800= 4x/y

=25x/ 2400 = 4x/ y

= y= 384

Average speed = 384 km/hr

Ques 3: A motor car does a journey in 10 hrs, the first half at 21 kmph and the second half at 24 kmph. Find the distance?

Sol:

Distance = (2 x 10 x 21 x 24) / (21+24)

= 10080 / 45

= 224 km.

Ques 4: A boy goes to school at a speed of 3 kmph and returns to the village at a speed of 2 kmph. If he takes 5 hrs in all, what is the distance between the village and the school?

Sol: Let the required distance be x km.

Then time taken during the first journey = x/3 hr.

and time taken during the second journey = x/2 hr.

x/3 + x/2 = 5 => (2x + 3x) / 6 = 5

=> 5x = 30.

=> x = 6

Required distance = 6 km.

Ques 5: Walking ¾ of his speed, a person is 10 min late to his office. Find his usual time to cover the distance?

Sol : Usual time = Late time / {1/ (3/4) - 1)

= 10 / (4/3 -1)

= 10 / (1/3)

= 30 minutes

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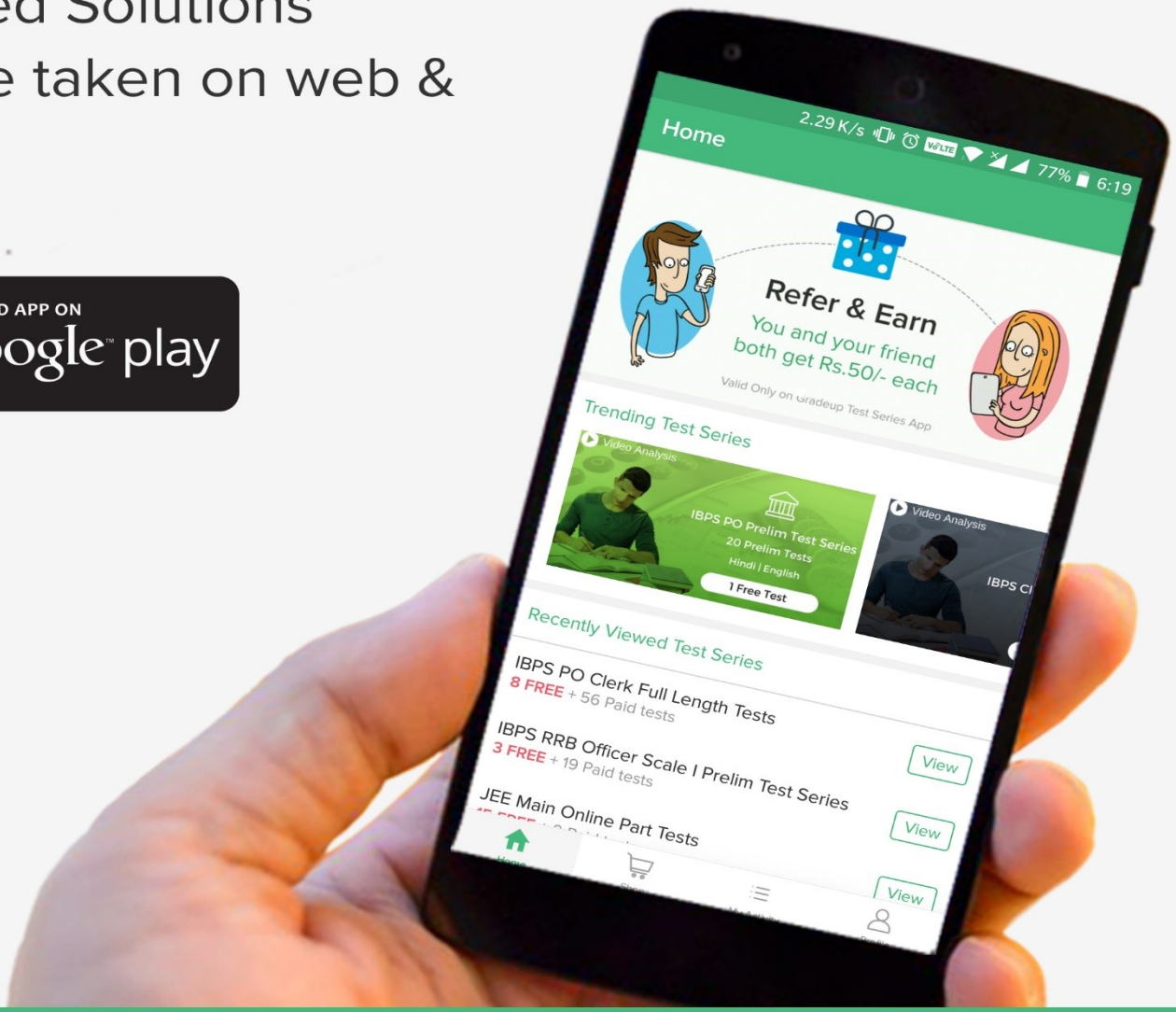

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